TESTIMONY

ANALYZING CHINA'S DEFENSE INDUSTRIES AND THE IMPLICATIONS FOR CHINESE MILITARY MODERNIZATION

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I would like to begin by thanking Chairman Robinson, Vice-Chairman D'Amato and the two co-Chairmen for today's session, Commissioners Ellsworth and Wortzel, for inviting me to speak today to US-China Economic and Security Review Commission. I commend the Commission for holding today's hearing on trends in Chinese military modernization and the implications for cross-Strait political-military relations. These are issues that have a direct bearing on US national security interests as well as those of US friends and allies in the Asia-Pacific region. China's rise as an economic and military power in Asia raises numerous questions about the future prospects for stability in the region. These are questions well worth dedicating significant time and resources to answer.

I have been asked to speak on the capabilities of China's defense industry - the part of the Chinese economy involved in the production of weapons systems and related military technologies. This is an issue that The RAND Corporation has lately devoted effort to researching, especially in light of the organizational changes within the Chinese military and the continued growth of the Chinese economy in recent years. The capabilities of China's defense industry has received far too little attention among the international community of China watchers. Important changes have occurred since the late 1990s, and these deserve closer scrutiny.

Overall Trends

In the last five years, China's defense industry has become far more productive than in past decades. The defense industrial reforms implemented in the late 1990s, unlike the one adopted in previous years, were substantial and have positively influenced the quality of China's defense industrial output. Gone are the days of widespread inefficiency and a paucity of innovation in defense production. Chinese defense firms have improved their R&D techniques, production processes and, thus, the quality of their output. These

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improvements have been gradual and incremental, but they can be expected to continue to accumulate in the future, assuming the Chinese economy continues growing. China's defense firms produce a wide range of increasingly advanced weapons that, in the short-term, are relevant to a possible conflict over Taiwan as well as China's long-term military presence in Asia.

To be sure, my argument is **not** that China's defense industry has been completely renovated and is now churning out global state-of-the-art weapons systems on par with major Western nations. Progress has been mixed across the defense industry and numerous systematic weaknesses remain. These continued problems should not be discounted. Rather, my argument to this Commission is that it is high time to revisit the conventional wisdom about China's defense industrial complex; the focus of current research needs to include the gradual improvements and future progress of China's defense industrial complex. Over the last 20 years, one of the most prominent and consistent conclusions drawn from research on China's defense industrial complex has been the weaknesses and limitations of Chinese defense production capabilities.[1] A new look at this critical issue is needed. The words of General Li Jinai, the head of China's General Armaments Department, testify to the salience of revisiting this topic, "there has been a marked improvement in national defense scientific research and in building of weapons and equipment. The past five years has been the best period of development in the country's history."[2]

What is China's Defense Industry?

China's defense industry is compromised of 11 state-owned enterprises that, in one form or another, have historically always been involved in production of military goods. These firms cover the general industrial areas of nuclear affairs, aerospace, aviation, shipbuilding, ordnance, and electronics. The companies are:

- China National Nuclear Group Corporation (www.cnnc.com.cn)
- China Nuclear Engineering and Construction Group Corporation (www.cnecc.com)
- China Aerospace Science and Technology Group Corporation (www.cascgroup.com.cn)
- China Aerospace Science and Industry Group Corporation (www.casic.com.cn)
- China Aviation Industry Group Corporation I (www.avicl.com.cn)
- China Aviation Industry Group Corporation II (www.avic2.com.cn)
- China State Shipbuilding Group Corporation (www.cssc.net.cn)
- China Shipbuilding Industry Corporation (www.csic.com.cn)
- China North Industries Group Corporation (www.norincogroup.com.cn)

[1] Bates Gill, "Chinese Military Technical Developments: The Record From Western Assessments, 1979-1999," as published in James C. Mulvenon and Andrew N.D. Yang, *Seeing Truth from Facts*, (Santa Monica, CA: The RAND Corporation, 2001.)

[2] Wang Wenjie, "Delegate Li Jinai Emphasizes: Grasp Tightly the Important Strategic Opportunity, Accelerate the Development By Leaps of Our Army's Weapons and Equipment," *Jiefangjun Bao*, 8 March 2003, p.1.

- China South Industries Group Corporation (www.chinasouth.com.cn)
- China Electronics Technology Group Corporation (www.cetc.com.cn)

Currently, these firms are not controlled by the Chinese military. Rather they are civilian entities under the authority of the State Council and its subordinate organ, the State Commission on Science, Technology and Industry for National Defense (COSTIND, *Guofang Keji Gongye Weiyuanhui*). These firms are contracted by the People's Liberation Army (PLA) to produce military items. China's defense industrial firms are completely different entities from the PLA-owned companies and factories (known as *jundui qiye* or military enterprises). The latter were set up and run by PLA authorities in the 1980s and 1990s until Jiang Zemin forced the PLA to divest from commercial business activities in 1999.[3]

Since the early 1980s, China defense industrial firms have diversified away from exclusive military production to producing civilian goods for domestic and international markets. This was an important part of Deng's Xiaoping's economic reform program which sought to lessen the defense industry's heavy reliance on government support. Current estimates of the amount of civilian production in each of the eleven large defense corporation ranges from 65% to 90% depending on the particular firm. Thus, even though these enterprises are officially considered by the government as defense industrial firms, they are also primarily involved in producing civilian goods and services, and thus are intertwined with China's huge civilian economy. In addition, there are a growing number firms that do not belong to the eleven defense-industrial conglomerates (especially in the information technology (IT) sector) which produce goods under contract for the military. The line between defense industrial firms and civilian firms in China is increasingly blurred, which complicates analysis of the performance of China's defense industrial base.[4]

Salience of Examining China's Defense Industry

The salience of researching China's defense industrial capability stems from several considerations which are directly relevant to today's hearing. First, Chinese leaders are unlikely to have a long-term policy of relying primarily on imported weapons. The ability of China's defense industries to produce modern weapons, therefore, will be an important determinant of China's future military power. Second**,** understanding China's defense industrial capabilities is critical to answering questions about whether China's has the ability to translate its growing economic resources into building a modern military.[5] Third, China's defense output serves as an indicator of national technological progress. China's ability to overcome some of the perennial weakness of its defense industrial

[3] James Mulvenon, *Chinese Military Commerce and U.S. National Security*, (Santa Monica, CA: The RAND Corporation, 1997).

[4] For example, according to one Chinese report, military industrial enterprises produced 780,000 automobiles in 2003, about 19 percent of China's total motor vehicle production. "China's Defense Sector Expands in 2003," *Xinhua* (english), 5 January 2003.

[5] China's *willingness* to devote national resources to military modernization in light of pressing social and development burdens (e.g. unemployment, banking reform, SOE reform, etc) is a separate but equally important question.

complex, such as systems integration and serial production of high-tech weapons platforms, may serve as a sign of a broader modernization in China's science and technology base.

Past Portrait of China's Defense Industry

For the past twenty years, the conventional wisdom has been that China's defense industry was broken, decaying and unable to meet the needs of a military in desperate needs of modernization. For much of that time period, that assessment was correct. China's defense industry exhibited numerous weaknesses at all levels of the system, from government procurement to factory production. At the level of government procurement, decisions about which company would produce a particular item were made by administrative fiat or ministerial bargaining rather through competitive bidding based on the relative capabilities of various manufacturers. As a result, defense producers had little financial interest in improving the quality of the weapons systems or the efficiency with which they manufactured or designed them. In such a regime, the ability to produce a quality product had a minimal relationship to the orders received or the profits generated.[6]

In addition to the lack of financial incentives for innovation, China's Soviet-designed approach to industrial organization also inhibited the supply of innovation. Under the Soviet model, R&D institutes were organizationally separate from the actual manufacturers. This feature was common, though not universal, in China's defense industry during the 1980s and 1990s. In addition, a hierarchical organizational structure discouraged the horizontal knowledge flows that are critical to technological progress.[7] This knowledge flow problem was undoubtedly exacerbated by the extreme secrecy associated with defense production in China.

Other major problems exhibited by China's defense enterprises included excessive capacity, redundant personnel, inflexibility in hiring and firing, loss of quality personnel to the non-state-owned sector, incorrectly priced inputs, poor management practices, and the inefficient geographic distribution of industry due to a 1960s and 1970s policy of relocating defense firms to remote interior areas known as China's "Third Line" (*disanxian*).

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[6] See John Frankenstein, "China's Defense Industries: A New Course?" in James C. Mulvenon and Richard H. Yang (eds.), *The People's Liberation Army in the Information Age*, (Santa Monica: CA: The RAND Corporation, 1999.) Jorn Brommelhorster and John Frankenstein (eds.), *Mixed Motives, Uncertain Outcomes: Defense Conversion in China*, Boulder, CO: Lynne Rienner Publishers, 1997; John Frankenstein and Bates Gill, "Current and Future Challenges Facing Chinese Defense Industries," The China Quarterly, June 1996, p. 394-427.

[7] Wendy Frieman, "China's Defence Industries," *The Pacific Review*, 1999; John Frankenstein and Bates Gill, "Current and Future Challenges Facing Chinese Defense Industries," op. cit; Frieman, Wendy, "Arms Procurement in China: Poorly Understood Processes and Unclear Results," in Eric Arnett, ed., *Military Capacity and the Risk of War: China, India, Pakistan and Iran*, (Oxford, England: Oxford University Press, 1997.)

The Chinese government's efforts in the 1980s and most of the 1990s to overcome these weaknesses was largely ineffective. Beijing relied on essentially two strategies: defense conversion and institutional reorganization. Both strategies, especially their poor implementation, failed to reform the operations of China's defense firms to make them more innovative and efficient. Defense conversion was a largely troubled process for most Chinese firms which found it difficult to convert easily their production infrastructure to producing civilian, commercial goods. Defense enterprises were hampered by legal constraints and difficulties in attracting foreign partners who could provide new capital, know-how and technologies. These problems were further exacerbated by the weaknesses in technology absorption capabilities, project management, and the technical skills of the labor force. As a result, many civilian goods produced by defense firms were low quality, uncompetitive and thus generated few profits.

Similar to China's experience with defense conversion, institutional re-organization was largely a cosmetic and ineffective pathway to substantial and sustained reform of China's decaying defense production capabilities. This approach involved a lot of changing of names and shuffling of organizational responsibilities but few of the systematic consolidation and rationalization measures needed to increase efficiency and bolster innovation.

The weaknesses of China's defense production capabilities over the last 20 years are reflected by two major indicators: (1) the technological backwardness of many of the systems produced in the 1980s and 1990s, and the long R&D and production timelines for most indigenously built weapons platforms; and (2) China's extensive purchases of major weapons systems from foreign countries. The history of China's defense industry is replete with examples of weapon systems with severe technological weaknesses and limitations. While many tanks, artillery, surface-to-air missiles, surface-to-surface missiles, surface ships, submarines, and air-to-air missiles entered service in the PLA since 1980, for the most part these new designs have been incremental improvements on earlier versions, which in many cases trace their lineage back to 1950s-era Soviet technology.

The Changing Shape of China's Defense Industry

In the late 1990s, the situation began to change. The government started to increase weapons procurement funding. From 1990 to 2002, the official defense budget allocation for weapons procurement grew from RMB 5 billion to RMB 57.3 billion. These increases are twice the rate of growth of the official defense budget. Also the share of the budget devoted to weapons procurement increased from 16.3 % to 33.8 % in this time period.[8]

Beyond increased funding for weapons procurement, the government finally adopted reforms which indicate a recognition of the depth of the problems in China's defense industrial system and the failures of past approaches. Beginning in Spring 1998 during the 9th Meeting of the National People's Congress, China's leadership initiated a new

[8] "Chinese Defence Industry: Chinese Puzzle," *Jane's Defence Review*, 21 January, 2004.

series of policies to reform the operation of the defense procurement system at the government-level and, second, to restructure the defense industries at the enterprise-level of operations. These policies initiated institutional changes in the management of China's defense industry in ways that outstrip past efforts in both scope and depth. These reforms also importantly began to influence incentive structures in the defense industry.

In March 1998, the government abolished the military-influenced Commission on Science Technology and Industry for National Defense (COSTIND), which had been created in 1982, and replaced it with a strictly civilian agency of the same name but under the control of the State Council. The old COSTIND, which reported to both the State Council and the military, had been very heavily involved in decisions on R&D and the purchase of military equipment. The restructured COSTIND's responsibilities, resources and authority were substantially circumscribed. It longer has a dominant role in decisions about PLA acquisitions of new military equipment or the direct management of defense industry enterprises. The restructured COSTIND, a shell of its former incarnation, is generally meant to function as the administrative and regulatory agency for China's major defense enterprises.

The second major organizational reform, following the "civilianization" of COSTIND, was the creation in April 1998 of a new general department of the PLA known as the General Armaments Department (GAD - *Zong Zhuangbei Bu*).[9] GAD assumed the responsibilities for military procurement of the old COSTIND combined with the roles and missions of other parts of the General Staff and General Logistics Departments involved in weapons procurement. The responsibilities of GAD include the life cycle management of the PLA's weapons systems (from R&D to retirement) and running China's weapons testing, evaluation and training bases.[10]

The significance of the "civilianization" of COSTIND and the creation of GAD is two-fold. First, these policy changes centralized China's military procurement system. Previously, responsibilities for PLA purchases were divided between numerous civilian and military organizations, each with distinct and conflicting interests. For example, COSTIND's former predominant influence in this process produced numerous inefficiencies. Second, the 1998 reforms separated the builders from the buyers. This organizational change further rationalized the procurement system and aimed to reduce conflicts of interest and corruption. GAD represents the PLA interests whereas COSTIND, as a civilian agency, now mainly handles industrial planning and the administrative affairs of defense firms.

In addition to these large organizational reforms, the government also adopted policies to streamline the weapons procurement process. In October 2002, Jiang Zemin signed an order promulgating and implementing a new set of regulations on military equipment

[9] The name of this organization has also been translated as the "General Equipment Department"; though the Chinese use the translation General Armaments Department.
[10] For an analysis of the GAD see Harlan Jencks, "The General Armaments Department," in James C. Mulvenon and Andrew N.D. Yang, *The PLA as an Organization v1.0*, (Santa Monica, CA: The RAND Corporation, 2003.)

procurement (*Zhonghua Renmin Jiefangjun Zhuangbei Caigou Tiaoli*).[11] These new regulations are meant to standardize, unify, and legalize the weapons procurement process.[12] The new regulations are also meant to accelerate the establishment of a competitive bidding system for PLA contracts, which was discussed in 1998 when GAD was formed.[13] The degree of their actual implementation in the procurement system is unclear, however.

Enterprise-Level Reforms

Beyond procurement reform at the government level of operations, Beijing in 1998 also adopted far-reaching policies to alter the relationship between the government and defense enterprises to bolster incentives for efficiency and innovation. The central government's main goals were to separate the government from enterprise operations, to make them more market-oriented by exposing them to the pressure of competition, to provide harder budget constraints, to make them less reliant on state subsidies, and to lessen the classic social burdens associated with the work-unit (*danwei*) system.

There are preliminary signs these policies have been effective. In some defense sectors (such as aerospace and shipbuilding), limited competition over entire systems, key sub-systems or parts has emerged or intensified. Competition in the sale of civilian goods produced by some defense firms has been most obvious and is likely improving the efficiency and modernization of their production processes. Defense enterprises have also benefited from the formation and exploitation of partnerships with civilian universities and research institutes to improve educational training relevant to defense technology development. This is particularly true in the IT sector. A limited amount of defense industry rationalization has occurred in recent years as well, though much more is needed given the large inefficiencies and redundancy still prevalent in the defense sector. Factories have either been closed down or transferred to provincial authorities. According to one source, 20% of the entire defense industry's workforce (estimated at between 2.5 and 3 million) have been laid off.[14] Furthermore, COSTIND and GAD have been effective at promoting R&D and production cooperation among defense enterprises located in various provinces. In the past, certain defense industrial sectors (such as the aviation industry) extensively relied on single source suppliers which contributed to inefficiency, redundancy, and high degree of insularity.

[11] In 1990, the Central Military Commission issued "Work Regulations for the Management of Weapons and Equipment." Since then, additional regulations have proliferated. Chinese media announced the promulgation of the new rules but have not made them publicly available. "Central Military Commission Chairman Jiang Zemin Signs Order Promulgating and Implementing Chinese People's Liberation Army Equipment Procurement Regulations," *Xinhua*, 1 November 2002.

[12] For research on China's past procurement processes see Ravinder Pal Singh, (eds.), *Arms Procurement Decision Making: China, India, Israel, Japan, South Korea and Thailand*, Stockholm International Peace Research Institute, (Oxford, United Kingdom: Oxford University Press, 1998.)

[13] "Government Procurement Again Recommended at NPC," *Xinhua*, 8 March 1999; *Jiefangjun Bao*, 9 February 1999, p.6.

[14] "Chinese Defence Industry: Chinese Puzzle," *Jane's Defence Review*, 21 January, 2004.

Growing access by Chinese firms to foreign weapons technologies (i.e. know-how and production technologies) is an additional variable. It has facilitated improvements in Chinese defense production capabilities. Aviation co-production with the Russians have helped Chinese aviation enterprises expand their knowledge of manufacturing fourth generation aircraft. The Israelis have provided assistance with avionics and air-to-air missiles; and the French have assisted with the development of air-to-air and surface-to-air missiles.

Some defense industrial sectors (such as shipbuilding and aviation) have also benefited from the access to foreign investment and foreign commercial technologies facilitated by joint-venture business activities. They have leveraged this commercial cooperation with foreign firms to renovate their production infrastructure and to modernize their operations. Other reforms worth watching include the use of capital markets in China and Hong Kong to generate funds which could conceivably be used for defense projects[15]; and reform of the ownership structures of the large 11 defense industrial enterprises to increase incentives for efficiency and innovation.

Status Report on Defense Industry Output

The above reforms combined with the sustained increased in procurement funding has led to a leaner and more capable defense industry in China. These improvements are reflected in the improving financial situation of major defense enterprises as well as the deployment of new generations of weapons systems. In 2003, the overall revenue of the defense industry was projected to grow by 18%; while "the total sales volume of manufactured goods and added industrial output value" were projected to grow by 25% and 20%, respectively.[16] COSTIND officials declared last year that in 2002 the defense industry (as an aggregate) broke even for the first time. By contrast, in the 1990s, China's defense industry annually ran deficits in excess of RMB 3-5 billion (US $375-$604 million.)[17] While these are official Chinese statistics of unclear reliability, they offer a general guide to the improving economic condition of China's defense industry as a whole. However, the economic performance of the 11 enterprises in the defense industry vary considerably. Some generate significant profits while others accrue major losses.

The changes in China's defense industry are most apparent in the military output of key defense enterprises.[18] In the last two years alone, Chinese defense factories have produced a variety of new weapons systems based on novel Chinese designs. Many are highly capable weapons platforms. The development of these weapons importantly reflects improvements in R&D techniques, design methods and production processes, especially compared to the 1980s and 1990s. Not only are the new systems more advanced, but China's production of them is faster and possibly more efficient.

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[15] Currently, over 30 Chinese firms linked to the defense industry are listed on Chinese stock exchanges.
[16] "China's Defense Sector Expands in 2003," *Xinhua* (english), 5 January 2003.
[17] Chinese Defence Industry: Chinese Puzzle," *Jane's Defence Review*, 21 January, 2004.
[18] For details on improvements in PLA capabilities see, *Annual Report On The Military Power Of The People's Republic Of China*, US Department of Defense, Report to Congress Pursuant to the FY2000 National Defense Authorization Act, 28 July 2003.

China's shipbuilding industry has been at the forefront of this trend. In the last 3-4 years, the Jiangnan Shipyard in Shanghai has build four new 7,000-ton destroyers based on stealthy designs and with improved air defense and anti-submarine capabilities. The serial production of these modern naval vessels is a first for China's shipbuilding industry. The construction of these destroyers occurred at an unprecedented rate compared to the two *Luhu* destroyers China built during in the entire decade of the 1990s. The production of these four vessels has also importantly utilized advanced, modular production techniques that facilitate quick and efficient construction. Their designs may also facilitate easy modernization of their weapons capabilities in the future. According to news reports, an adjacent shipyard in Shanghai is also producing four new frigates based on a new design and with improved weapons capabilities.[19] Other shipyards are producing newly designed conventional and nuclear submarines as well as a variety of auxiliary vessels for the Chinese Navy. According to the 2003 Department of Defense (DOD) report on Chinese military capabilities, China's Song-class conventional submarine "has several features that point to a major shift in diesel submarine design philosophy" such as the use of a skewed propeller.

China's aerospace industry has improved its ability to serial produce short-range ballistic missiles (SRBMs). According to the 2003 DOD report, China has now deployed around 450 SRBMs opposite Taiwan. This estimate reflects a increase in the annual production rate of SRBMs from 50 per year to about 75 per year. The accuracy and lethality of these systems is improving as well. China is moving towards satellite-aided navigation for some SRBMs which would boost substantially their accuracy. Parallel research on new conventional warheads for these missile systems would increase their destructiveness. China is continuing to make progress on the development of a land attack cruise missile. The aerospace industry has also built anti-ship cruise missiles comparable to the US Harpoon. The capability of China's aerospace industry is further evident in the production of higher quality satellites. In recent years, the military started shifting from relying on state-owned civilian satellites to a constellation of military-dedicated satellites for navigation, communications and reconnaissance.

The modern capabilities of China's defense electronics and IT sectors has facilitated the modernization of PLA's command, control, communications, computers and intelligence (C4I) systems. The Chinese military is in the midst of a C4I revolution, characterized by the wholesale shift over the last twenty years from relatively insecure analog communications to digital, secure communications via fiber optic cable, satellite, microwave, and enhanced high-frequency radio. Specifically, the PLA has:

- laid thousands of kilometers of buried fiber optic cable connected by modern switches and routers, extending high-speed, secure communications to nearly every unit in the force;
- deployed large computer network intranets on this fiber backbone, dedicated to operational command and control, training, logistics, finances, and education, among other subjects;

[19] Yihong Chang, "China's Launches Second Guided-Missile Destroyer," *Jane's Defence Weekly*, 5 November 2003.

In the future, the PLA will continue to build an infrastructure that is increasingly digital, automated, encrypted, faster, secure, and wider in terms of bandwidth. [20]

The pace and depth of these advances cannot be explained by traditional Chinese defense-industrial dynamics, but instead spring from a paradigm known as the "digital triangle," which resembles a classic techno-nationalist strategy, with high-level bureaucratic coordination and significant state funding. The three vertices of the "digital triangle" are (1) China's booming commercial information technology companies, (2) the state R&D institute and funding infrastructure, and (3) the military. For the PLA, the "digital triangle" offers great gains in some crucial information technology areas, but the operational impact is uncertain. The introduction of secure communications, for instance, has likely improved communications and operational security, but the impact of these systems on actual warfighting performance cannot be known with absolute certainty prior to conflict.[21]

Uneven Progress

These improvements in China's defense industrial capabilities have not been universal. Many of the classic structural weaknesses persist in parts of the defense industry. Much more consolidation and rationalization needs to occur to make the majority of China's defense enterprises efficient, innovative and, perhaps, even profitable. As with the economic reform of much of China's overall economy in the last twenty years, the successes in the defense industry have been gradual, uneven, and mixed.

Some of the best performers among defense enterprises have been the two aerospace conglomerates, the two shipbuilding conglomerates, and defense electronics firms. Nuclear industry and ordnance industry enterprises have long suffered losses. China's aviation industry, for example, has experienced some successes in recent years with the production and deployment of military platforms such as the JH-7 (FBC-1), the J-10 (F-10) multi-role aircraft and the Su-27 project with the Russians. Yet, the first two planes have been under development for 20 years. In addition, China aviation industry still can not produce a turbo-fan engine or advanced fire-control systems for its newest fighters. Many of the aviation platforms China is now building and deploying still utilize foreign imports for the most crucial subsystems such as propulsion, avionics and fire-control. In the aerospace industry, Chinese firms have been slow to produce a highly capable air-defense system, relying on imports form Russia. China's most capable naval air-defense system under development, the HQ-9, is a Chinese version of a Russian system. As many scholars have noted before, systems integration remains a weaknesses for Chinese defense enterprises, though the advances noted above suggest that progress is being made on this issue.

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[20] James Mulvenon, "The Digital Triangle: A New Defense Industrial Paradigm," in Kent H. Butts and Edward L. Hughes, *Economics and National Security: The Case of China*, (Carlisle, PA: US Army War College, August 2002.)

[21] James Mulvenon, "The Digital Triangle," op.cit.

Conclusions and Implications

A new paradigm is needed to analyze China's defense industrial capabilities. The PLA has increased funding for weapons procurement from domestic defense enterprises. At the same time, the government initiated a slate of unique reforms to renovate this long-moribund and decaying part of China's economy. The newest defense industrial reforms, in contrast to the multiple failed efforts of the 1980s and 1990s, have brought about changes in institutions and incentives at both the government- and the enterprise-levels of operation in China's defense industrial system. These policy changes have produced successes as the financial health of defense firms improves. Certain defense industrial conglomerates are no longer operating at a net annual loss, according to official numbers. Chinese defense factories have begun producing a modicum of new weapons systems and platforms that represent qualitative improvements from past years. The truncated production cycles and use of more modern production processes are equally important advances in defense industrial capabilities.

Much more research is needed to track these trends and, most importantly, to understand how fast and why these improvements are occurring. To be sure, some of these trends are a result of the fact they government is throwing more money at the problem. As procurement funding goes up, key problems, such as resources constraints and bottlenecks, get resolved. Similar phenomena have occurred in defense industries around the world. Yet, further research is needed to determine the relative influence of the recent organizational reforms on the output and operations of China's defense enterprises. Also, better metrics are needed to measure the relative benefit of civil-military integration on the capabilities of defense enterprises.

China's defense industries will increasingly play a pivotal role in the future direction and military competence of the PLA. As the PLA shifts away from purchasing complete weapons systems from foreign suppliers to requesting technology transfers, China's defense production capabilities will become a critical factor in the PLA's long-term effort to renovate its force structure. Thus, the issue of China's defense industry is a crucial and increasingly important variable in the complex and evolving equation of PLA modernization.